MAR 18 1989

FEMA 209 260529

FLOOD INSURANCE STUDY

CITY OF BANGOR, MICHIGAN

VAN BUREN COUNTY

MAY 4, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER 260529

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

CITY OF BANGOR,
VAN BUREN COUNTY,
MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Bangor, Van Buren County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Detroit District, (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 12. This study was completed in May 1987.

1.3 Coordination

Streams requiring detailed study were identified at a meeting on January 31, 1985, attended by representatives of the Study Contractor, FEMA, and the City of Bangor.

Results of the technical aspects of the study were furnished for review to the Michigan Department of Natural Resources (MDNR), the State coordinating agency, and to FEMA's Region V Project Officer (PO). The MDNR did not concur with the hydrologic analysis; however, the PO, upon review of the submitted information, authorized the COE to submit the report as completed, without the State's approval.

On June 3, 1988, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Bangor, Van Buren County, Michigan. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of the South Branch Black River, Maple Branch, and Boyer Drain within the corporate limits of Bangor was studied in detail.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1992. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Bangor.

2.2 Community Description

The City of Bangor, located 10 miles from Lake Michigan, is 29 miles west of Kalamazoo, Michigan, in northwestern Van Buren County, and is surrounded by the unincorporated areas of the county. Bangor has an area of approximately 1.5 square miles. The main transportation routes serving the City of Bangor are State Highway 43 and the CSX railroad. The 1980 population of Bangor was reported to be 2,001 (Reference 1).

The climate of Bangor is characteristic of southern lower Michigan and varies from modified marine to continental. The mean annual temperature is 48 degrees Fahrenheit (°F), with extremes ranging from -24 °F to 108 °F. The average annual precipitation is 33 inches and is fairly well distributed. The average annual snowfall is about 70 inches. The average annual runoff is approximately 17 inches. The topography in Van Buren County varies from level to moderately hilly.

Land use in Bangor ranges from commercial and residential to undeveloped. In the floodplains along the South Branch Black River, Maple Branch, and Boyer Drain most of the land is undeveloped.

2.3 Principal Flood Problems

Based on gage records on the South Branch Black River near Bangor, periods of high runoff have occurred at any time from early winter through late summer. The larger events have occurred in spring. However, flooding in surrounding areas shows the potential also exists for major flooding to occur due to summer precipitation patterns.

On April 18, 1975, a total of 3.75 inches of rain fell in Bangor in a six-hour period. Based on rainfall frequency analyses, the resulting flood was determined to be a 71-year event. The flood caused minor damage within the city, the sanitary sewer pumping station on Arlington Road was

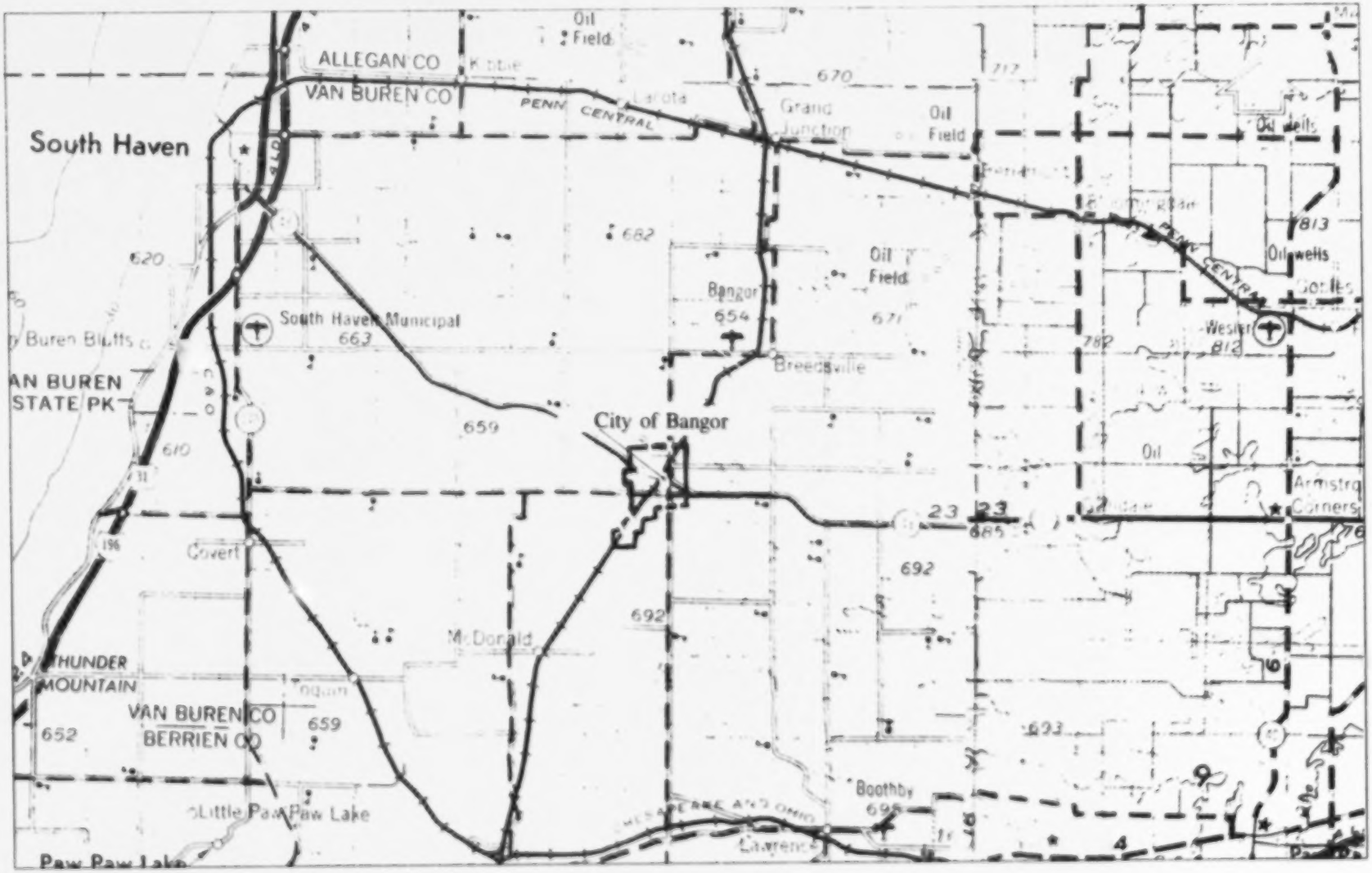


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BANGOR, MI
(VAN BUREN CO.)

APPROXIMATE SCALE

2 0 2 4 6 MILES

VICINITY MAP

temporarily put out of service, and the Bangor weather station was flooded. Both the Lions and the Kiwanis Parks were flooded but were not damaged. In addition, floodwaters from Maple Creek caused the closing of Arlington Street.

2.4 Flood Protection Measures

Flood protection measures are not known to exist within the study area. The low weir located under the Second Street bridge over the South Branch Black River is small, with little storage capacity. No attenuation of flood peaks would be expected.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The hydrologic analysis of the South Branch Black River is based on an analysis of gage records. A discharge-frequency analysis was performed for the 1967 to 1984 period of record for the gage, which is located 4.9 miles northwest of Bangor (References 2 and 3). The HECWRC computer program, which is based on criteria in U.S. Water Resources Council Bulletin 17B (Reference 4), was used to determine the discharge-frequency relationship using a generalized skew of -0.20 taken from a COE study (Reference 5). The drainage-area ratio method was used to adjust the frequency analysis flows at the drainage area gage for points of interest on the South Branch Black River.

Since Boyer Drain and Maple Creek are not gaged, the U.S. Geological Survey regression equation method was used (Reference 6). The soil types

and areas for the regression equations were determined from the maps referenced in an MDNR report (Reference 7). The basin boundaries were transferred from topographic maps.

Peak discharge-drainage area relationships for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SOUTH BRANCH BLACK RIVER					
just downstream of confluence of Maple Creek	70.7	1,130	1,510	1,670	2,070
just upstream of confluence of Maple Creek	54.6	900	1,200	1,330	1,650
MAPLE CREEK					
at mouth	16.1	320	500	590	820
just upstream of confluence of Boyer Drain	13.8	280	450	540	770
just upstream of confluence of Cedar Drain	7.3	140	220	260	340
BOYER DRAIN					
at mouth	1.2	40	60	70	95

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section data for the backwater analyses were obtained by a field survey completed in January 1986. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and on the Flood Insurance Rate Map.

Channel and overbank roughness coefficients (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observation of the streams and floodplain areas. The roughness values

for the main channels of the streams studied varied from 0.030 to 0.045 for all floods. Roughness values for the overbank areas ranged from 0.030 to 0.080 for all floods.

The starting water-surface elevation for the South Branch Black River at the downstream corporate limit of Bangor was determined by beginning the computations 2,600 feet downstream and using the slope-area method. The starting water-surface elevations for Maple Creek and Boyer Drain were also found by the slope-area method, with the computations beginning at the mouths of the streams.

Water-surface elevations of floods of the selected recurrence intervals were computed using the HEC-2 step-backwater computer program (Reference 8).

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals. In cases where the 50- and 100-year flood elevations are close together, due to limitations of the profile scale, only the 100-year profile has been shown.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The profile for the South Branch Black River was computed without stop logs in place at the Second Street Dam, based on present operating procedures. The water-surface elevation upstream of the Second Street bridge could be as much as 6 feet higher than computed if the stop logs were in place. The flood elevations shown on the profiles are considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the map and described in the exhibit labeled Elevation Reference Marks.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:6000 with a contour interval of 4 feet (Reference 9).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In Michigan though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 10), encroachment in the floodplain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the MDNR, Division of Water, a floodway having no more than a 0.1-foot surcharge has been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and the 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodways for South Branch Black River and Maple Branch lie outside the corporate limits.

Along Boyer Drain, where no floodway has been computed, the community must ensure that the cumulative effect of development in the floodplain will not cause an increase in the base flood elevations greater than the state's allowable surcharge at any point within the community.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
SOUTH BRANCH BLACK RIVER								
A	0	478[3]	1137	1.5	630.0	630.0	630.1	0.1
B	2040	315	812	1.6	631.1	631.1	631.2	0.1
C	4600	56	321	4.1	632.6	632.6	632.7	0.1
D	5815	65	369	3.6	634.5	634.5	634.5	0.0
E	6710	129	631	2.1	638.9	638.9	639.0	0.1
F	6845	80	523	2.5	638.9	638.9	639.0	0.1
G	10,320	334	1331	1.0	639.8	639.8	639.9	0.1
H	11,340	249	801	1.7	640.0	640.0	640.1	0.1
MAPLE CREEK								
A	510[2]	75	131	4.5	631.1	630.2[4]	630.3	0.1
B	1120[2]	34	136	4.3	632.2	632.2	632.2	0.0
C	4730[2]	75	191	3.1	638.3	638.3	638.4	0.1
D	5150[2]	44	183	3.2	639.1	639.1	639.2	0.1
E	5450[2]	170	638	0.9	641.9	641.9	642.0	0.1
F	6220[2]	163	725	0.8	645.2	645.2	645.3	0.1
G	7770[2]	372	1290	0.4	645.3	645.3	645.4	0.1
H	9950[2]	175	341	1.6	645.6	645.6	645.7	0.1
I	11,200[2]	189[3]	321	0.8	646.4	646.4	646.5	0.1
J	12,790[2]	152[3]	138	1.9	647.4	647.4	647.5	0.1
K	14,090[2]	125	120	2.2	649.8	649.8	649.9	0.1

[1]FEET ABOVE CORPORATE LIMITS
[2]FEET ABOVE MOUTH
[3]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS
[4]ELEVATION WITHOUT CONSIDERING BACKWATER EFFECT FROM SOUTH BRANCH BLACK RIVER

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BANGOR, MI
(VAN BUREN CO.)

FLOODWAY DATA

SOUTH BRANCH BLACK RIVER—MAPLE CREEK

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than the state's allowable surcharge at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

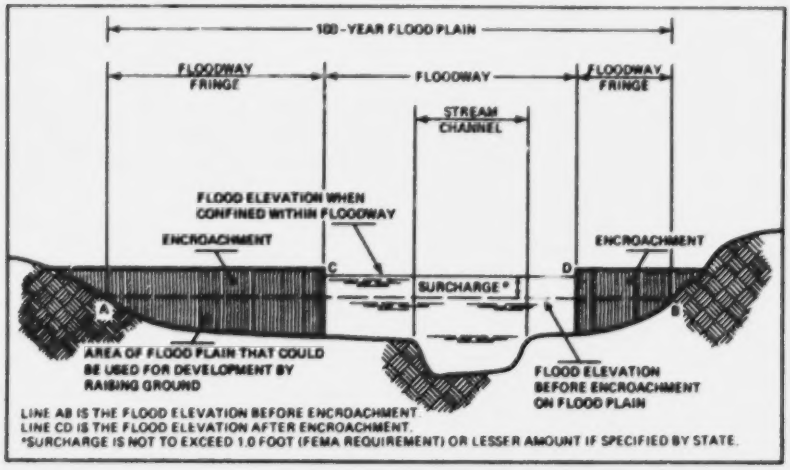

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1

foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The Flood Insurance Rate Map printed for the Township of Arlington, Michigan (Reference 11) is in agreement with this study.

This Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Bangor, Michigan (Reference 12).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 175 West Jackson Boulevard, 4th Floor, Chicago, Illinois 60604.

9.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Michigan, Washington, D.C., January 1982.

2. U.S. Geological Survey, Water-Supply Paper 1677, Magnitude and Frequency of Floods in the United States, Part 4, St. Lawrence River Basin, 1965.

3. U.S. Department of the Interior, Geological Survey, Water Resources Data for Michigan, Part 1, Surface Water Records, 1962-1982, Lansing, Michigan.

4. U.S. Department of Interior, Geological Survey, Interagency Committee on Water Data, Office of Water Data Coordination, Hydrology Subcommittee, Bulletin No. 17B, Guidelines for Determining Flood Flow Frequency, September 1981, revised March 1982.

5. U.S. Army Corps of Engineers, Detroit District, Development of Generalized Skew Coefficients for Use in Estimating Flood Flow Frequencies, Detroit, Michigan, 1979.

6. U.S. Department of the Interior, Geological Survey, Water Resources Investigation Report 84-4207, Statistical Models for Estimating Flow Characteristics of Michigan Streams, Lansing, Michigan, 1984.

7. Michigan Department of Natural Resources, Geological Survey Division, Sponsored in part by U.S. Geological Survey, Quaternary Geology of Michigan with Surface Water Drainage Divides, W.R. Farrand and D.L. Bell, 1984.

8. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, April 1984.

9. Aerial Survey Corporation, Topographic Maps of Bangor, Michigan, Scale 1:6000, Contour Interval 4 Feet: Bangor, Michigan, 1985.

10. State of Michigan, Flood Plain Control Act of 1968, Act 245, P.A. 1929 as amended by Act 167, P.A. 1968, Michigan Water Resources Commission, Lansing, Michigan, 1968.

11. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Arlington, Van Buren County, Michigan, July 1985.

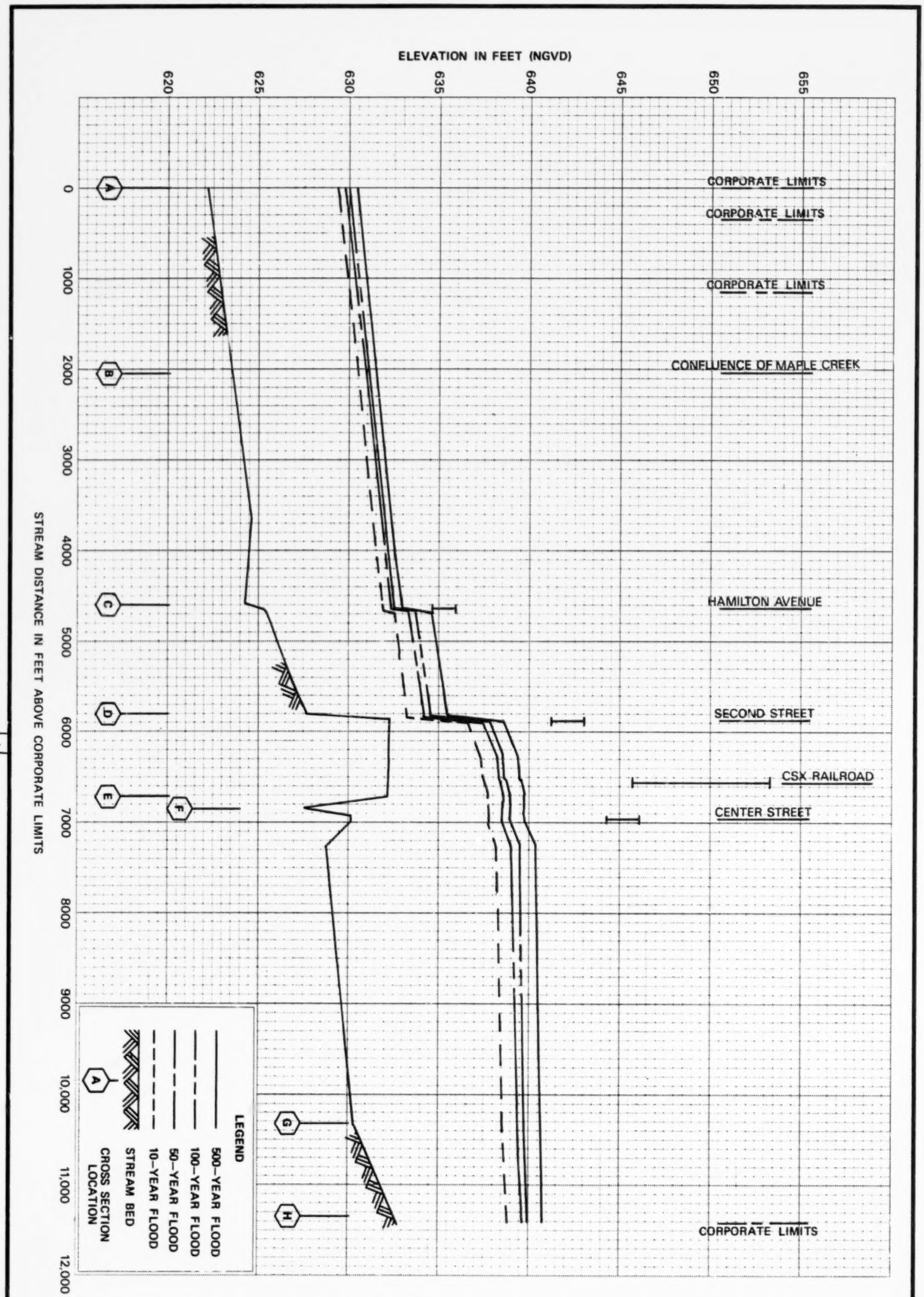
12. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Bangor, Van Buren County, Michigan, September 1975.

ELEVATION REFERENCE MARKS

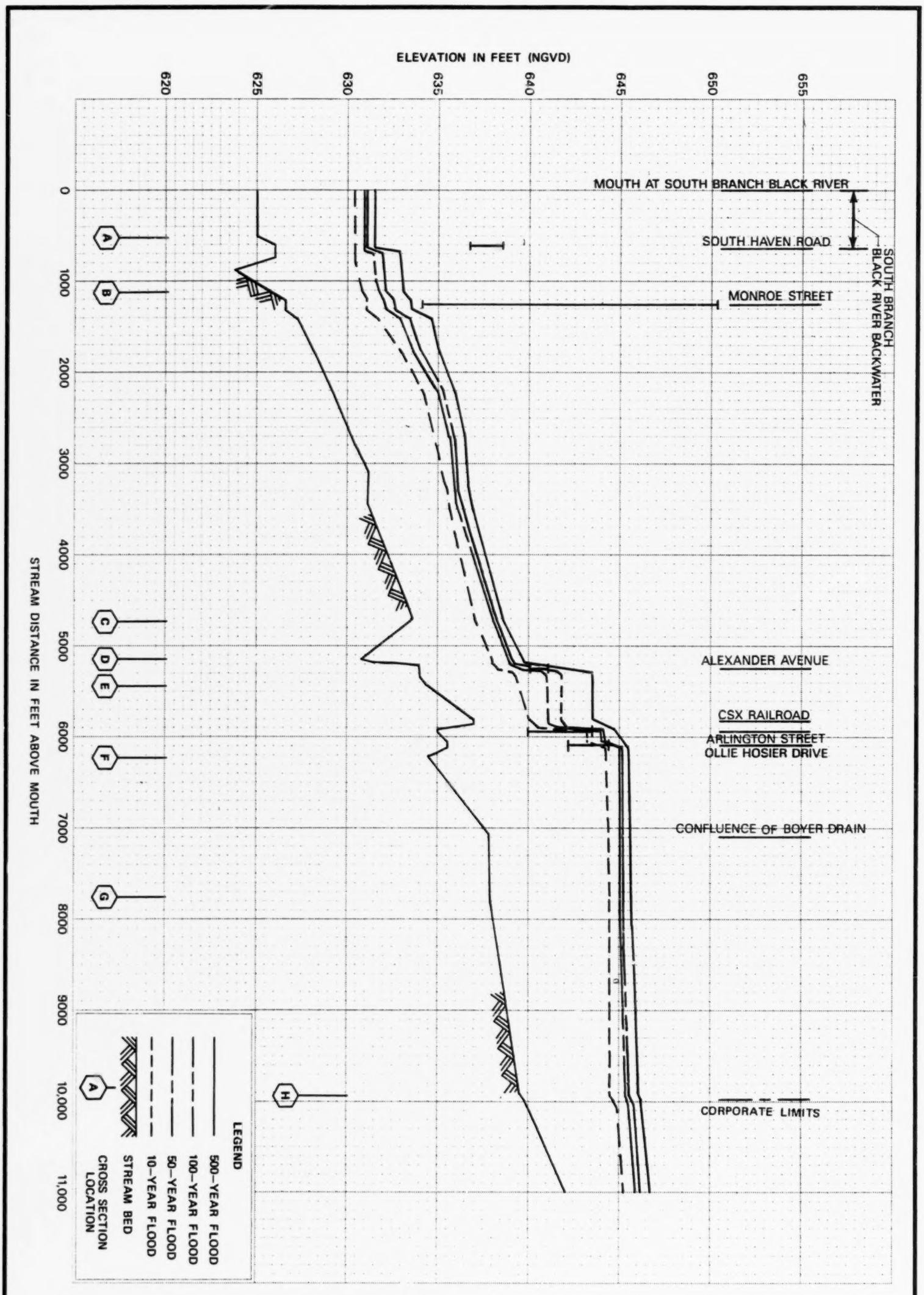
REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
1	0001	658.89	standard disk on top of south abutment of Arlington Street underpass for CSX railroad
2	0001	652.92	standard disk on east end of south abutment of CSX railroad bridge over the South Branch Black River
3	0001	655.75	top operating nut of hydrant on northeast corner of Arlington and Alexander Streets
4	0001	669.01	top operating nut of hydrant on northwest corner of Industrial Park Drive and Arlington Street
5	0001	654.44	northeast bolt of fire hydrant on southwest corner of Washington and Lincoln Streets
6	0001	667.33	north hose connection of fire hydrant on southwest corner of Center and Bangor Streets
7	0001	653.05	manhole rim at Main and Second Streets
8	0001	646.31	chiseled "V" painted red on northwest abutment of Center Street bridge over the South Branch Black River
9	0001	642.74	chiseled "L" painted over on southeast abutment of Second Street bridge over the South Branch Black River
10	0001	636.48	chiseled "4" painted red in top of bolt in 8" x 8" timber near guardrail at southwest corner of Hamilton Avenue bridge over the South Branch Black River
11	0001	652.95	south hose connection of fire hydrant on northwest corner of Main Street and Third Street

ELEVATION REFERENCE MARKS (Continued)

REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
12	0001	640.72	chiseled "L" in rail at northwest corner of South Haven Road bridge over Maple Creek
13	0001	660.70	top of inlet dome at southwest corner of Cass and Hamilton Avenues
14	0001	642.95	chiseled "L" painted red at southeast corner of Arlington Street bridge over Maple Creek
15	0001	653.32	pole barn nail in north face of 4-inch cottonwood tree southwest of intersection of 34th Avenue and Maple Creek
16	0001	648.63	railroad spike in east face of power pole, I & ME Company, V310-280, near southeast corner of Walnut Street bridge over Boyer Drain
17	0001	647.28	chiseled "U" in top of east end of concrete culvert on Center Street at Boyer Drain



01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **CITY OF BANGOR, MI** (VAN BUREN CO.)	**FLOOD PROFILES** **SOUTH BRANCH BLACK RIVER**



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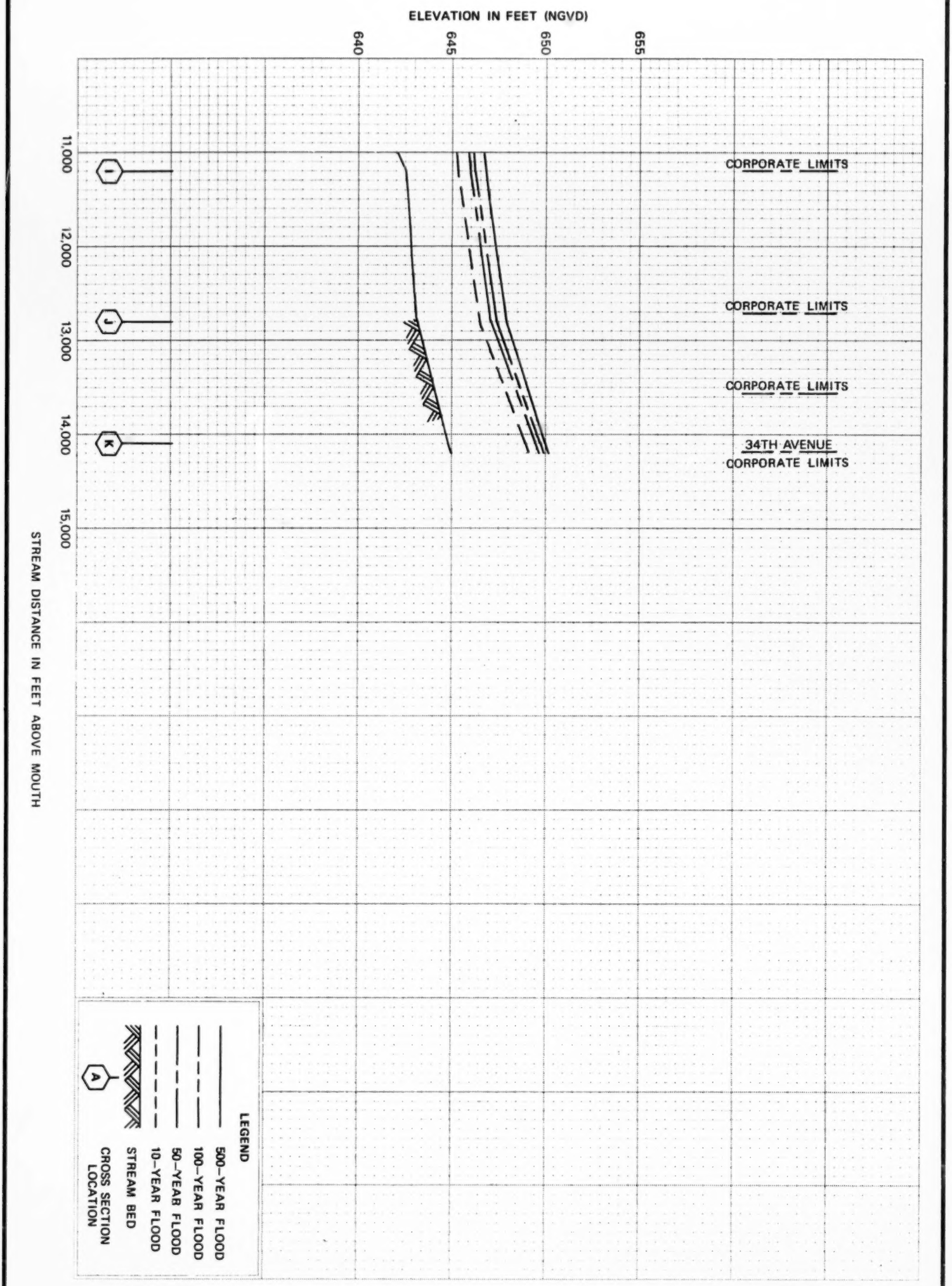
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

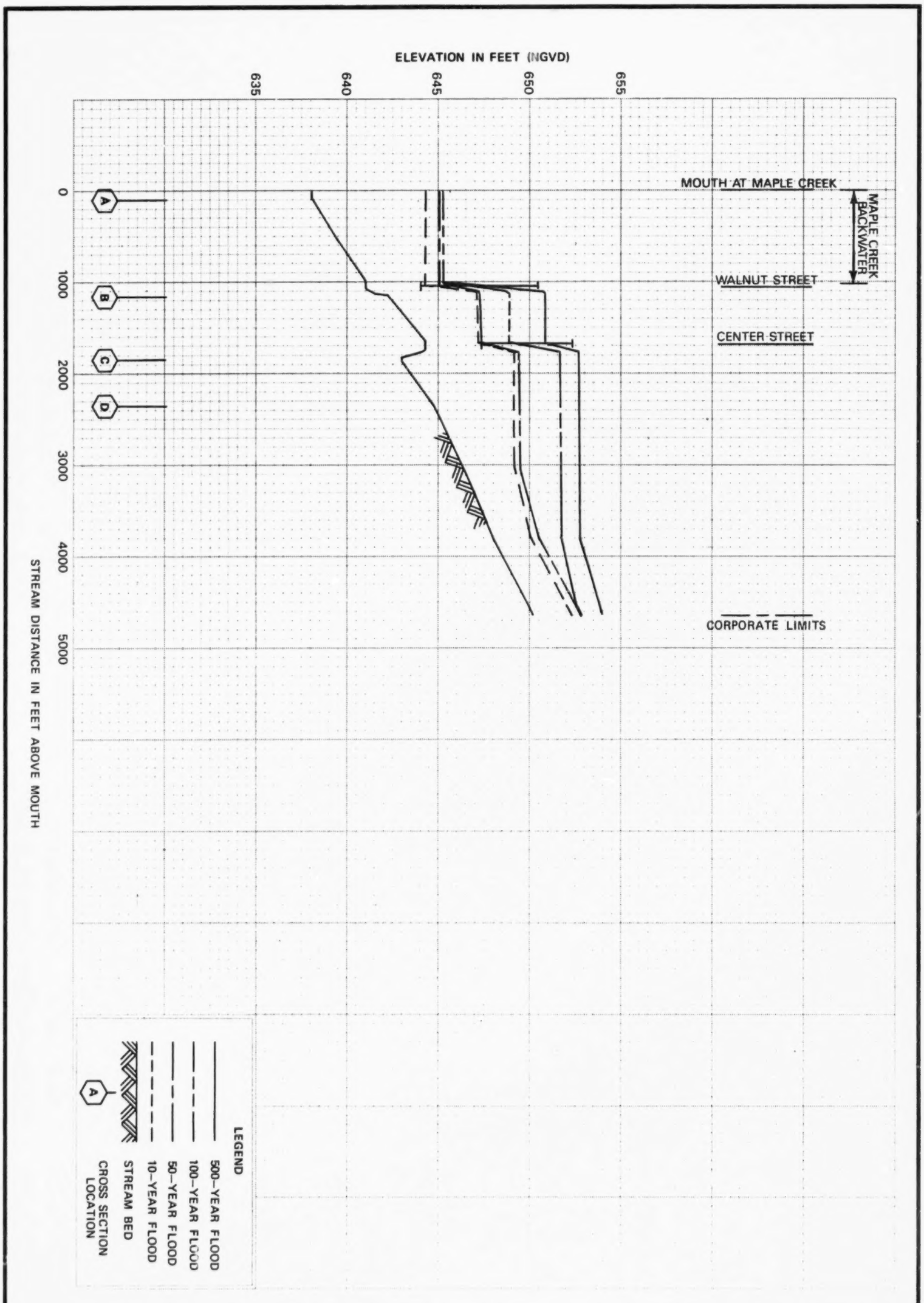
CITY OF BANGOR, MI
(VAN BUREN CO.)

FLOOD PROFILES

MAPLE CREEK



03P	FEDERAL EMERGENCY MANAGEMENT AGENCY **CITY OF BANGOR, MI** (VAN BUREN CO.)	**FLOOD PROFILES** **MAPLE CREEK**



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04P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BANGOR, MI
(VAN BUREN CO.)

FLOOD PROFILES

BOYER DRAIN